VOL. XI, NO. 10.—BOTANICAL GAZETTE.—OCT., 1886.

Memoranda of a revision of the North American Violets.[1] I.

ASA GRAY.

It seems most natural to throw all the Candollian groups into one, except the section *Melanium*, which includes the pansies; in this, following the late M. Boissier; and to arrange our violets in six primary sections, upon characters of vegetation taken along with differences in the stigma.

GROUP I. Strictly acaulescent; the dissected leaves and scapes all directly from an erect and short thick caudex rather than rootstock, never stoloniferous: corolla beardless: large antrorse-terminal stigma wholly beakless and naked.

V. pedata L., with var. **bicolor** Pursh, fide Raf.

GROUP II. Acaulescent; the leaves and scapes springing directly from the summit of a rootstock, or later more or less from runners: style with inflexed or truncate and beardless summit and an antrorsely beaked or short pointed small stigma.

* Rootstocks thick and short, multicipital, ascending or little creeping, never filiform nor stoloniferous, often fleshy-dentate: corolla only saccate-spurred, blue or violet, occasionally varying to white; at least lateral petals bearded. Species connected by transitions.

V. pedatifida Don. Syst. i. 320 (1831). *V. delphinifolia* Nutt. in Torr. & Gray, Fl. i. 136 (1838). This earlier name clearly belongs here and must be adopted. It is the *V. pinnata* of Richardson (not the Linnæan species, which has longer and narrower spurs), the *V. pedata* of Hooker's Flora as to the plant of Saskatchĕwan, etc. It has often been confounded with that species; but its affinities are with *V. palmata*, indeed is probably only a marked geographical variety of that species, with all the leaves finely dissected. It might take the much earlier name of *V. digitata* Pursh, except that Pursh founded it on a Virginian specimen, which he had seen in Major Le Conte's herbarium. The latter, however, makes no mention of it in his monograph; but we suppose it to be his *V. septemloba*, the variety of *V. palmata* which comes nearest to the present species. Indeed, the late Professor Tuckerman long ago collected at Concord, Massachusetts, specimens which would surely pass for *V. pedatifida* if from the valley of the Mississippi.

[1]Read before the A. A. A. S., Buffalo meeting, 1886.

V. palmata L. In the year 1856, in the second edition of my Manual, this was combined with *V. cucullata*, following the general conviction of our botanists; repeated studies during thirty years confirm the opinion. But *V. cucullata* Ait. ought to have been referred, as an entire-leaved variety, to the Linnæan *V. palmata*. I am the more constrained to do so now by the fact that the name *cucullata* would have to give way to the much earlier-published *V. obliqua* Hill, well figured and unmistakable in his Hortus Kewensis. To the various synonyms already adduced to the more or less cut-leaved forms of this multifarious and widely diffused species, I have only to add that of *V. digitata* Pursh, as suggested above.

Var. **cucullata**, the *V. cucullata* of Aiton (1789) and *V. obliqua* Hill (1769), with abundant synonymy, is characterized only negatively by the absence of cut leaves, and every one of its many forms is liable to have them, most so those which affect dry or sandy soil. Yet they have not been found at either the most northern or the farthest western limits of the species.

V. sagittata Ait. Generally well-marked as this is, yet it appears to be confluent on one hand into typical *V. palmata*, on the other into the var. *cucullata*.

* * Rootstocks thickish and creeping, stoloniferous, comparatively large-flowered: corolla blue or violet, with white varieties; lateral petals usually bearded; spur short and saccate: leaves cordate and merely crenulate.

V. Langsdorffii Fischer in DC. Arctic Alaska to Brit. Columbia, extending, I believe, to the Sierra Nevada in the state of Nevada. Quite distinct, as Maximowicz insists, from the more caulescent *V. mirabilis*.

V. odorata L., the Sweet Violet of the Old World, beginning to be naturalized.

* * * Rootstocks long and filiform (not thickened nor scaly except at base of old flowering growths), extensively creeping underground, sometimes in summer along the surface in shade, leaf-mould, etc.

+ Corolla blue or purple, large-spurred, beardless.

V. Selkirkii Pursh, fide Goldie. Our identification of this northern species with *V. Kamtschatica* of Gingius in DC., and with *V. umbrosa* of Fries, appears to be confirmed. Few botanists are aware that *John Goldie*, the first describer of this marked species, and of several other Canadian plants, lived down to the present summer, dying at a great age, at Ayr, Ontario, June 1886.*

+ + Corolla blue or purple, short-spurred, smaller.

*See sketch of Goldie's life, p. 272, this number.

V. palustris L. In this country only alpine or subalpine, Labrador to Saskatchewan and Rocky Mountains, south to those of Colorado, and the higher parts of those of New England.

+ + + Corolla white, mostly with brown-purple lines on lower or also on lateral petals or a blotch, these bearded or beardless in the same species; spur short and saccate: stigma as if truncate and margined, antrorsely short-pointed. The three species run together.

V. blanda Willd. Geographical range fully as large as that of *V. palmata*. To this I refer two forms, which in their extremes would seem specifically distinct, viz.:

Var. **palustriformis**. Comparatively large, growing in shady or mossy and loose soil or leaf-mould, where it is freely and extensively stoloniferous: upper face of the leaves commonly hirsutulous in the way of *V. Selkirkii*, but less so: scapes often reddish: flowers rather larger; lower petal less lineate or picturate. This is *V. obliqua* Pursh (not Hill nor Ait.), and may also be his *V. clandestina* (in the summer state it is abundantly cleistogamous, and is the *V. amœna* of Le Conte). It ranges from Canada to Delaware, and to the mountains of Utah, but passes freely into the ordinary type. In the dried specimens it so much resembles *V. palustris* that Sir Joseph Hooker not unnaturally referred the whole of *V. blanda* to that species.

Var. **renifolia**. *V. renifolia* Gray, Proc. Am. Acad. viii. 288, which seems quite different from the ordinary state of *V. blanda* by its round reniform and beneath soft-pubescent leaves, is so connected with the preceding variety that it can not be kept distinct. It also grows in wet mossy woods and swamps, from Nova Scotia to the district north of Lake Superior, and south to Massachusetts and central New York.

V. primulifolia L., including *V. acuta* Bigelow, in its various forms, as is well known, fills up the interval between *V. blanda* and *V. lanceolata*. It is an Atlantic coast species, except as to

Var. **occidentalis**. A form with ovate- or spatulate-oblong leaves, all tapering at base, coll. by T. Howell, much out of the ordinary range, at Waldo, S. Oregon, along streamlets.

V. lanceolata L. has a rather larger range, from Nova Scotia to Lake Superior, Florida, and Texas.

+ + + + Corolla yellow; lateral petals usually bearded.

V. rotundifolia Michx. Our only truly acaulescent yellow violet, well marked in its summer state by the unusually accrescent leaves lying flat on the ground. From the character and

habitat this should be, in its cleistogamous-flowering summer state, the *V. clandestina* of Pursh.

GROUP III. Subcaulescent by leafy stolons, or caulescent, with ascending 2-3-leaved stems, slender, almost glabrous, multiplying by long filiform rootstocks: leaves all reniform or cordate, undivided: corolla a bright yellow, with saccate spur: stigma terminal, beardless and beakless.

V. sarmentosa Dougl. To this belongs *V. rotundifolia* Hook. in Lond. Jour. Bot. vi. 73, in Geyer's collection, a species which it considerably resembles at first, flowering direct from the rootstock.

V. biflora L. Always caulescent, no leafy stolons; stigma margined on two sides. In this country known only from the Colorado Rocky Mountains; in the Old World ranges from Kamtschatka and Japan to Europe.

Synopsis of North American Pines, based upon leaf-anatomy.[1] I.

JOHN M. COULTER AND J. N. ROSE.

(WITH PLATE VIII.[2])

The genus Pinus is very naturally circumscribed, but its species have always been notably difficult of discrimination. This has arisen partly from the real difficulty of the subject, partly from the imperfect material found in our collections, and mostly from the insufficiency of the characters used. The oldest division of the genus was based upon the number of leaves in the bundles, and this must still be considered a supplementary character of considerable importance. In late years, however, it has been discovered that most valuable characters are to be found in the internal structure of the leaves, meaning, of course, the secondary or foliage leaves. The great diversity in the structure of these leaves is in marked contrast with the uniformity found in leaves of higher plants, and of itself is no mean argument in defense of the position of gymnosperms as the lowest of phanerogams.

---

[1] Read before the A. A. A. S., Buffalo meeting, 1886.

[2] EXPLANATION OF FIGURES.—1. *P. Strobus*, 2 dorsal peripheral ducts, stomata on ventral faces, and single fibro-vascular bundle, X54; 2. *P. clausa*, 2 parenchymatous ducts, stomata on all faces, and 2 fibro-vascular bundles, X54; 3. *P. Cubensis*, internal duct, X54; 4. *P. Arizonica*, 3 cells of the bundle-sheath with thick outer walls, X250; 5. *P. monophylla*, thin-walled bundle-sheath, X250; 6. *P. aristata*, strengthening cells next the epidermis, X250; 7. *P. flexilis*, thin-walled layer (pitted) next the epidermis, X250; 8. *P. tuberculata*, thin-walled layer between epidermis and strengthening cells, X250.

In 1865 F. Thomas, in Pringsheim's *Jahrbucher*, iv. pp. 23-63, first called attention to these leaf characters as means of classification. The other authors upon this subject have been C. E. Bertrand, *Bull. Soc. Bot. France*, xviii. pp. 376–381, 1871, and *Ann. Sci. Nat. Bot.*, xx. pp. 5–153, 1874; W. R. McNab, *Proc. Irish Acad.*, ii. pp. 209–213, 1875, and in the same journal, pp. 673–704, 1877; E. Purkinje, of Austria, has also made studies, but his results have not been learned. Probably the most diligent and successful investigator of this subject was the late Dr. Geo. Engelmann, whose name in connection with this group of plants is the most familiar in this country. Some of his conclusions have been published in his "Synopsis of American Firs," published in 1878 in the *Trans. St. Louis Acad.*, iii. pp. 593–602, and particularly in his "Revision of the genus Pinus," published in 1880 in the same journal, iv. pp. 161–189. It is upon this last contribution that the work recorded in the present paper was based. Dr. Engelmann made use of the characters obtained from leaf-structure to define many of his subdivisions of the genus, but did not carry them on into the species. Our object has been, in the first place, to verify his work; in the second, to make use of these characters in the discrimination of species.

No reference will be made to any other than leaf characters, but it is far from the intention to claim that other characters are to be discarded. The leaf characters are rather given as confirmatory and supplemental, and in some doubtful cases decisive. The permanency of these internal structural characters, as compared with those which are external, is evident, but even with this, care should be taken not to place too implicit confidence in them. They should be used in connection with the ordinary external characters, though it is claimed here that almost all species of pines can be determined by a single leaf. The value of such characters is thus seen, not only in confirming those obtained from scales and cones, but in deciding upon our too numerous herbarium specimens which lack complete material, or in fossil botany in the determination of species or relationships. In several cases it will also be noted these characters serve to separate forms which have been doubtfully placed together, and more frequently to bring together certain forms which have been kept apart as doubtful species.

It will be observed that Dr. Engelmann's arrangement, in the main, has been confirmed, trifling modifications here and there being made to better express what is conceived to be true relationships. The necessity of a lineal arrangement, of course, distorts many of the facts, but we believe it to be the most natural yet suggested.

The number of species of American pines, exclusive of Mexico, as given by Prof. C. S. Sargent, in the tenth census report, is thirty-five. These have all been examined, as well as eight or ten Mexican species, which are also included. The material has been obtained from the Harvard herbarium, from other well known herbaria, and also from the very instructive slides prepared by the Rev. J. D. King, whose material was obtained from Prof. Sargent. Effort was made to obtain material from as wide a range as possible, and repeated studies of the same forms were constantly made.

Transverse sections of the leaf are used, and these should always be made well away from either its base or apex. Neglect of this precaution has led to confusion, as a leaf with two distinct fibro-vascular bundles, may be thought to have but one if the section is made near the extremities. The bundles usually separate above the base of the leaf, and blend again near its apex, and in poorly developed leaves may never appear separate at all. This led Dr. Engelmann to say that the single or double bundle "is of very little diagnostic importance, as we find occasionally single or double bundles in the same species,"[1] while, with the precaution mentioned, we have known it to fail but once.

The outline of a transverse section, in the main, depends upon the number of leaves in a fascicle, but this can not be pressed too far. In P. monophylla the outline is nearly circular, in 2-leaved species it is semicircular, in 3-leaved species triangular, but in 5-leaved species it is also triangular. It is thus usually possible to determine approximately the number of leaves in a fasicle by the transverse section of a single one, and hence the number of leaves will also be legitimately included among our anatomical characters.

The leaf-structure is separable into three regions, the cortical, the mesophyll and the fibro-vascular.

I. *The cortical region.* This is composed of one layer of epidermal cells, with very thick walls, interrupted here and there by stomata. The position and number of rows of stomata are valuable characters. In some species, as P. Strobus, they are found only on the ventral side; in others, as in P. Coulteri, they occur both dorsally and ventrally. The rest of the cortical region is made up of the so-called "hypoderma," being mostly very thick-walled cells, aptly called by Engelmann "strengthening cells" Engelmann rejected the term "hypoderma," because cells of the same nature often occur about the resin ducts and in the fibro-vascular region. The term "strengthening cells," therefore refers to this thick-walled tissue wherever found, and they may be cortical, about the

[1]Trans. St. Louis Acad., iv. 165.

ducts, or central. The term "hypoderma" still has its use, however, as it contains another group of cells which we have called "thin-walled cells," to distinguish them from the strengthening cells. This thin-walled layer frequently occurs between the epidermis and the cortical strengthening cells, and its presence or absence is a character of considerable importance. Seven of our species have an hypoderma composed only of these thin-walled cells, with no cortical strengthening cells; eight or nine species have no thin-walled layer between the epidermis and the cortical strengthening cells; while the remainder have the thin-walled layer between the epidermis and strengthening cells. By "thin-walled cells" it must be understood that we are speaking comparatively, as they are by no means thin-walled in fact, but contrasted with the epidermal and strengthening cells are decidedly so. Rarely is there any difficulty in distinguishing this layer, but occasionally, as in P. monticola, the thin-walled layer shades into the strengthening cells.

II. *The mesophyll region.* This is chiefly composed of large chlorophyll-bearing parenchyma cells, with very characteristic infoldings, which are of no diagnostic value. In this region, however, are found the resin ducts, and their position and size furnish very important characters They are found in three positions, viz.: *peripheral,* when they lie next to the cortical region; *parenchymatous,* when completely surrounded by the mesophyll; *internal,* when next to the bundle-sheath. The terms "external," "medial," and "internal" would better express their relation to the mesophyll region, but the former terms were given by Dr. Engelmann, and there is no good reason for changing them. A little confusion in these terms also arises from the fact that in two species resin ducts have been occasionally discovered in the fibro-vascular region, viz.: P. sylvestris,[2] to which we add P. serotina. Dr. Engelmann considers the positions of these ducts in the mesophyll region as the most useful diagnostic character obtained from the leaf-structure. However, even this character can not be relied upon exclusively, as variations from the normal position are apt to occur. This variation does not consist in changing the normal position, but in the development of accessory ducts in some other position, or in the change in position of a single one of the normal ducts. To Dr. Engelmann's list of these variations we have added ten or twelve species, showing that such variation is not unlikely in the whole genus. All the resin-ducts are lined with a layer of thin-walled secreting cells, outside of

[2]Arthur, Barnes and Coulter, Hand-book of plant dissection, p. 167.

which, in many cases, are thick-walled strengthening cells, either scattered about the duct or forming a compact sheath.

III. *The fibro-vascular region.* A very distinct bundle-sheath invests this region, the cells of which are either comparatively thin-walled, or with the outer wall excessively thickened. This has been a useful character in some of our subdivisions, but is not always constant. P. Sabiniana, P. Coulteri, and a few others may or may not have the bundle-sheath with thickened outer walls. In the center of this region occur the fibro-vascular bundles, either one or two. This character we have used as one of the best for separating the genus into two sections. As has been mentioned, Dr. Engelmann considered it of but slight diagnostic importance, but we have found no character less likely to fail. In the examination of many hundreds of sections but one was different from the expectation in this regard. The bundles are always together at the base and apex of the leaf, and may be widely separated during the remainder of their course, but even when they are in contact they can easily be distinguished as two. In the use of the terms "dorsal" and "ventral", when speaking of the leaf surfaces, the former is applied to the phloem side, the latter to the xylem. Strengthening cells may or may not be found about the fibro-vascular bundles, and this is such a constant character as to be of good service in classification. The rest of the fibro-vascular region is filled with parenchyma cells and tracheids, neither of which are of any diagnostic value.

Using the structural characters described the following synoptical arrangement of our pines, including some Mexican species, is presented, for the purpose of supplementing other characters, for use in the absence of other characters, and to indicate relationships.

‡1. Fibro-vascular bundle one: leaves mostly in fives.

*A thin-walled layer next the epidermis (somewhat thickened in P. monticola): no strengthening cells next the epidermis nor about the ducts: leaves always in fives.

† Stomata on dorsal side of leaf.[3]

1. **P. albicaulis** Engelm. Epidermis mostly very thick-walled: one to three rows of dorsal stomata: two dorsal ducts (.050–.070 mm.); often a ventral duct, sometimes one or more smaller accessory ones: thin-walled cells about ducts larger than those next the epidermis: leaves 2 in. long.

Along the Coast Range, from California to British Columbia.

[3] This does not mean that there are no ventral stomata.

First described by Engelmann in *Trans. St. Louis Acad.*, ii. 209; then reduced by him to a variety of the next species in *Bot. Calif.*, ii. 225; finally restored to specific rank by the same author in BOT. GAZETTE, vii. 4. Several specimens labeled P. aristata in herbaria belong here.

2. **P. flexilis** James. Epidermis not so thick-walled: one to four rows of dorsal stomata: two dorsal ducts (.030–.045 mm.); rarely a ventral one: thin-walled cells about ducts equalling those next the epidermis: leaves 2–4 in. long.

Western slope of Rocky Mountains to California.

The extreme forms of these two species stand well apart, but there are intermediate forms which are hard to determine.

† † No stomata on dorsal side of leaf (often present in P. monticola).

3. **P. reflexa** Engelm. Three or four rows of stomata on ventral faces: two dorsal ducts (.025–.040 mm.): number of cells in bundle-sheath 16–20: fibro-vascular bundle often quite large, almost filling the fibro-vascular region, which often has strengthening cells, differing in this respect from the other species of the group and resembling P. cembroides: leaves 1–2 in. long.

High mountains of New Mexico and Arizona.

First described as a variety of P. flexilis by Engelmann in *Bot. Wheeler's Report;* then raised to specific rank in BOT. GAZETTE, vii. 4.

4. **P. Strobus** L. Three to five rows of stomata on ventral faces: one to three ducts (.035–.040 mm.), mostly two and situated half way between the middle and edge of the dorsal face; when three the odd one is on one of the ventral faces: number of cells in bundle-sheath 15–19, mostly 16: leaves 3–4 in. long.

Along the Alleghanies and in the northern states east of the Mississippi.

5. **P. Ayacahuite** Ehrenberg. Much like the last, but with a few more cells in the bundle-sheath (18–21), and always two dorsal ducts, which are much smaller (.015–.025 mm.).

Mountains of Mexico.

6. **P. monticola** Doug. Two to six rows of ventral stomata, often one or two dorsal rows: mostly two dorsal ducts (.025–.050 mm.), sometimes but one; often a few ventral ducts: number of cells in bundle-sheath 20–25: leaves 2–4 in. long.

Mountains of the Pacific slope.

The thin-walled layer next the epidermis, which is characteristic of this group, is not so evident as in the other species, but can be distinguished from the strengthening cells. It marks well a transition phase to the next group.

* * No thin-walled layer next the epidermis: strengthening cells next the epidermis and generally about the ducts: leaves one to five.

† Stomata on dorsal side of leaf.

7. **P. Lambertiana** Doug. Two to six rows of stomata on each face of the triangular section: always two dorsal ducts, often one between, occasionally some ventral ducts which are sometimes parenchymatous, no strengthening cells in fibro-vascular region: leaves 3–4 in. long.

In the Sierra Nevada and Coast Range.

Schluss folgt 302

Notes on the mode of pollination of Asclepias.

CHARLES ROBERTSON.

(WITH PLATE VIII.)

In regard to the visitors of Asclepias Cornuti, Dr. Hermann Müller observes that they "slip upon the smooth parts of the flower until a foot enters the wide inferior part of the slit, in which it at last gets a firm hold".[1] Mr. T. H. Corry[2] describes the insect as grasping the back of a nectary, and plunging its proboscis into its cavity, "endeavoring at the same time to get a firm and sure foothold on the unstable flowers", until the insect at length places one of its feet into the wider part of an alar fissure.

Having collected insects on the flowers of six species of Asclepias, I regard the normal action of the most common and most efficient to be that they hold on to a flower, or several flowers, in such a way that their feet go down below the angles of the alæ, and when the legs are drawn upwards they are caught between the strongly projecting hoods and guided by them over the entrance of the stigmatic chamber, which occupies the narrow interval between their bases. Of native insects, the most common visitors I have observed on A. Sullivantii, are humble bees (Bombus separatus, B. Pennsylvanicus, and B. scutellaris) and Danais Archippus. The feet of humble bees reach down as far as the bases of the petals, and I have often found the pollinia fastened upon their tibial spurs as well as on their claws. I have also found pollinia of this species on the spurs and claws of Danais Archippus, and high up on tarsal hairs of Prionony x

[1] "Befruchtung der Blumen", 1873, p. 336. "The Fertilization of Flowers", translated by D'Arcy W. Thompson, B. A., 1883, p. 398.

[2] "Structure and Development of the Gynostegium and on the Mode of Fertilization in Asclepias Cornuti, Dec.," Trans. Linn. Soc. Lond. Bot. 2d Ser. Vol. II., part 8. 1883, pp. 186, 187.

Thomæ[3]. In a similar way, a specimen of Scolia bicincta shows pollinia of A. Cornuti on the tarsal hairs. However, the gynostegia of these species are so large that the feet of many visitors will not reach far below the angles of the wings, and, when this occurs, the claws are the only parts which are readily caught. The importance of the hoods in guiding the legs of insects over the angles of the wings, is more apparent in the smaller flowered species, since the more delicate wings catch hairs which are not only very fine and short, but which are also situated much higher up on the legs. Thus, hive bees caught on A. Sullivantii and A. Cornuti, show pollinia only on their claws and pulvilli, but they have the pollinia of A. tuberosa, A. incarnata, and A. verticillata scattered upon the hairs of the tarsi. A specimen of Argynnis Cybele, which I caught on A. Cornuti has pollinia of this plant on its claws and pollinia of A. tuberosa on the tarsal hairs. Again, a specimen of Papilio Asterias caught on A. tuberosa has pollinia of A. tuberosa on the hairs of the tarsi and of A. Sullivantii on the claws. Although the pollinia are fastened to different parts, I see no reason for supposing that the action of the insect differs on the different plants. To show how high the pollinia are fastened upon the legs of insects, I may mention that I have found the pollinia of A. incarnata on the hairs of the tibiæ of humble bees 7mm. above the claws, and on Papilio Cresphontes and P. Turnus as high as 9mm. H. Müller gives a figure of the leg of a butterfly showing eleven corpuscula, seven of which are fastened above the claws, four forming a combination on a tibial spur. [4]Dr. A. S. Packard, Jr., figures a Tachytes (?)[5] showing pollinia much as they appear on visitors of the smaller flowered species. In addition to those mentioned above, I have found, among the visitors of A. incarnata, A. verticillata and A. tuberosa, insects of the following genera with pollinia upon the hairs of the tarsi above the claws: Apathus, Melissodes, Ceratina, Magachile, Epeclus, Halictus, Vespa, Polistes, Odynerus, Cerceris, Crabro, Pelopœus, Ammophila, Stizua, Bembex, Astata, Tachytes, Pompilus, Priocnemis, Myzine, Pieris, Colias, Libythea, Conops, Midas, Trichina, and Euphoria. A theory of pollination can not, therefore, be limited to an account of the insertion of pollinia which are attached to the claws; and it is

[3]A specimen of Sphex Pennsylvanica in the collection of Prof. S. A. Forbes at Champaign, Ill., has pollinia which I refer to A. Sul ivantii similarly situated on its legs.

[4]"Fertilization of Flowers", fig. 133.

[5]Am. Nat., vol. I., p. 105, and "Guide to the Study of Insects", p. 165. Dr. Packard regards the tarsus as that "of a wasp belonging probably" to Tachytes. Mr. W. H. Patton, in Proc. Bost. Soc. Nat. Hist., XX., p. 397, says, "Indeed, that figure bears a resemblance to the tarsus of Tachytes, but represents tolerably well the tarsus of Sphex, an insect of a different family".

claimed for the view maintained in this paper, that it will account for pollination as readily in the one case as in the other and by the same mode.

H. Müller, who supposes that the whole foot enters the stigmatic chamber, says: "When the insect tries to draw its foot out in order to proceed further, the diverging claws are caught by the apposed edges of the anther-wings, and guided upwards in the slit, so that one or other of the two claws is brought without fail into the notch in the lower border of the corpusculum and there held fast[6]." On the same subject Mr. Corry observes: "When the foot reaches the superior end of the alar chamber in which it has been guided, one at least of the two hooked claws upon it, or some part of the foot in the case of Diptera, must easily enter the hollow cavity of the corpusculum, which lies in such a position that this result is inevitable[7]." The importance which these authors attach to the view that the whole foot enters the chamber, in my opinion, rests on a misunderstanding of the mode of insertion of the pollinia, and has led them to overlook the precision with which a corpusculum comes to be fastened to a hair or claw. The corpusculum is placed so nicely at the top of the wings that its cleft is fairly continuous with the slit between them (fig. 2 *c*.), and I can not conceive that the contrivance works normally unless the particular part, *i. e.*, a single claw, hair, or pulvillus to which the corpusculum becomes attached, is caught between the wings and guided by them into the cleft. Believing that all processes are caught as the leg of the insect passes over the angle of the wing, I suppose that only a single process is caught and that a claw is caught in exactly the same manner as a hair or spur. In a careful examination of the feet of 116 hive-bees which were killed by being caught on the flowers of A. Sullivantii, I have found that, with but two exceptions, when a foot was held by the wings, only one claw was between them, the other being free, or less often the pulvillus was held between the wings and both claws were outside.

When first withdrawn the pollinia lie in the same plane (fig. 4.) In a few minutes the twisting of the retinacula brings the pollinia into nearly parallel planes, but the upper ends are still separated by quite an interval (fig. 5.) According to the authors to whom reference has been made, the pollinia are inserted by the corpusculum. From the analogy of observations made on the movements of the pollinia of some Orchidaceæ some ad-

[6] Ibid, p. 398.

[7] Ibid, p. 188.

vantage might be looked for in the slow movement of the pollinia of Asclepias. Indeed, Mr. Corry, who has observed this phenomenon in A. Cornuti, states that it is of advantage, although he fails to show it; and I think it impossible so to do on the supposition that the pollinia are introduced by the corpuscula. He says: "Some considerable time, moreover, must elapse after the pollinia are extracted before the corpuscular appendages are so far dried that both pollinia of the same corpusculum can be introduced through the fissure into the alar chamber, and in the meantime the insect has had time to reach another flower or plant[8]." On another page he observes: "If the movement did not occur on the part of the pollinia their broad surfaces would lie at right angles to the alar fissure, and their insertion into it in this position through the notch would in consequence be rendered a much more difficult, if not an altogether impossible operation; or else the pollinia in being slipped in would become folded in the opposite direction, and the less curved border which emits no pollen tubes would be first inserted into the fissure[9]." But what is to prevent this consequence before the movement takes place? Whatever might happen there is obviously nothing to render the introduction of the corpusculum itself more difficult before the movement occurs than afterwards, so that the slowness of the movement is hardly an advantage under this view. If the corpusculum were very slender or flattened so that a thin edge could be presented to the slits, there would be no difficulty in understanding how it could readily slip into the stigmatic chamber; but it is a rounded body, and is relatively large in comparison with the entrance to the cavity. Of course, if the whole foot of an insect commonly enters the stigmatic chamber it is not hard to understand how the corpusculum should go in with it. But when the corpusculum is fastened to a hair which is directed outward and downward from the leg of the insect, and which is often so short that the corpusculum is fairly in contact with the leg, the difficulty increases. In the examination of the feet of hive bees killed on the flowers, I have failed to find a single case in which a corpusculum was attached to that part of the foot which was held between the anther wings. In my opinion, therefore, the structure of the corpusculum is so far from facilitating the introduction of the pollinia that it prevents the part to which it is attached from being again caught in the slits; and, until the

[8] Ibid. p. 195.
[9] Ibid, p. 190.

movement occurs, the corpusculum with its two pollinia will pass over the entrance to the stigmatic chamber without being injured.

After the movement occurs, if the corpusculum be examined from one side (fig. 6), it will be observed that the retinacula project outward and downward. Since the parts to which the corpuscula are attached themselves project outward and downward, the retinacula finally stand nearly at right angles to the leg of the insect. The retinaculum, near the point where it joins the pollinium, is bent rather suddenly, so that the pollinium appears to be flexed upon it. This flexure, which Mr. W. H. Leggett[10] has called the knee, is very prominent. There is quite an interval between the knees, and the membrane of the retinaculum at the knee is expanded transversly to the plane of the pollinium (fig. 5 *k*.) Robert Brown[11] has observed in A. purpurascens, that the part of the retinaculum extending between the knee and the pollinium remains attached to the latter when it is found in the stigmatic chamber. This expansion of the membrane serves to prevent the withdrawal of the pollinium after it has been inserted into the cavity, and, when drawn against the closely apposed edges of the alæ in the upper part of the stigmatic chamber, facilitates the rupture of the retinaculum. Judging from the structure of parts which are readily caught between the anther-wings, nothing could be more natural than for one of the knees to slip into the entrance to the stigmatic chamber, and the movement is intended to turn them into such a position that this will occur. When, therefore, the movement has taken place and the insect draws its leg over the angle of the wings, the corpusculum with the claw or hair to which it is attached passes on without being caught, while one of the knees of the pollinia readily enters the stigmatic chamber and the pollinium enters with it. When the knee has reached the upper part of the cavity and will go no further, the retinaculum is torn across and escapes, leaving the pollinium in position to effect fertilization.

In repeated trials at artificial pollination of the flowers of A. Cornuti, A. Sullivantii, and A. incarnata, I succeeded three times, in the case of A. Sullivantii, in separating the pollinium from the retinaculum without withdrawing the latter from the slit, and thus was enabled to insert a pollinium and to draw out a corpusculum at the top of the alæ with its two pollinia by the same movement. But in all other cases a pull that seemed sufficient to break the rectinaculum freed it from the slit so that the corpusculum at the top remained intact. Accordingly, I have seen

[10] Bull Torr. Bot. Club, Vol. III, p. 35.

[11] Trans. Linn. Soc. Lond., Vol. XVI, p. 724.

no difficulty, on the supposition that the pollinia are introduced by the knees, in the observation of H. Müller, who says: "In several flowers which I dissected the corpuscula and pollen masses were still in their places, though pollinia, which must have come from other flowers, had been inserted into the stigmatic chambers[12]."

In a number of cases observed by me on A. Sullivantii the movement which turns the knees toward the flower is completed in about seven minutes, though it has proceeded sufficiently in five minutes to turn the flexure far enough to render its insertion quite likely. With the view of pollination stated in this paper, the slow movement is plainly of advantage, because a knee can hardly be caught by the wings until it has occurred.

Now, since only one pollinium is inserted into the stigmatic chamber, there is an economic disposal of the pollinia. The interval between the flexures is so great that only one of them can be caught, while the other passes by the slit uninjured. There are, therefore, two chances of a pollinium being transferred to another plant. If both pollinia were left at each act of pollination, there would be but one chance of cross fertilization. Moreover, the chances of cross fertilization would be reduced from the fact that the stigmatic chambers would be more nearly filled by pollinia from the same source, while if they are introduced singly, there are more chances of a chamber receiving a pollinium from a distinct plant.

As two pollinia are fastened together, there would be but one chance of pollination occurring if the pollinia were inserted by the corpuscula, while there are two chances of a knee being caught. When a pollinium has been removed, the broken retinaculum may be caught in a slit and remove a second corpusculum with its two pollinia. When this combination of two corpuscula and three pollinia is drawn over the angle of the wings, there are three chances of a pollinium being caught. Whenever a pollinium is removed, two new pollinia may be substituted for it and a large combination of pollinia may result, arranged either in a unilateral series or dichotomously. In either case, the chances of the insertion of a pollinium equals the number of pollinia in the combination. If the foot to which the first corpusculum of the combination is attached must enter the stigmatic chamber, of course, there would be but one chance of pollination taking place without regard to the number of pollinia. Such an accident would be likely to destroy the whole combination. As already observed, on the large flowers of A. Sullivantii and A.

[12] Ibid, p. 400.

Cornuti the shorter hairs on the legs of insects are not readily caught, so that the number of parts to which the corpuscula may be attached are reduced to a minimum. For instance, the only parts on the leg of a hive bee which can remove the corpuscula of these species are the two claws and the pulvillus. The leg will thus remove three corpuscula, and since these bodies render useless the parts to which they are attached, the broken retinacula not only take the place of the parts disqualified, but increase the number of parts to which the corpuscula can be attached. By means of these combinations, therefore, the leg of an insect has its capacity for carrying pollinia greatly increased.

Mr. Corry, referring to the simplest form of combination, viz., two corpuscula and three pollinia, says: "This combination being inserted into the alar fissure, as the single corpusculum was previously, one of the two lower pollinia is left detached in the lower part of the chamber, while its appendage, becoming caught at the upper part in the fissure of the corpusculum which lies there, carries it away, forming a combination of three corpuscula and four pollinia[13]." This suggests a most serious objection to the view that the pollinia are introduced by the corpuscula. It makes a mystery of the mode of retention of the pollinia, for how are we to understand how one pollinium is retained after the foot with two corpuscula and two pollinia have escaped. However, so long as the combination remains uniserial, Mr. Corry finds no difficulty in its passage through the stigmatic chamber; but when it becomes dichotomous the difficulty becomes insurmountable, and, to account for this form, he makes use of the theory which I have applied throughout. He says: "These corpuscular combinations are, however, frequently more or less regularly dichotomous in their arrangement, and this can only occur by one of the projecting corpuscular appendages, either with or without a pollinium attached to it, becoming caught in the open lower extremity of an alar chamber; it is then drawn upwards in the cavity, its pollinium, if it has one, is usually detached in the lower part, and then in any case the appendage simply passes upwards as the insect raises its leg and lifts out the corpusculum situated at the apex of the chamber, along with its pair of appended pollinia. I am unable to conceive that this dichotomous form can be brought about in any other way, since the alar chamber is in all cases of much too contracted dimensions to admit of the passage of any form of combination except a unilateral series such as that previously mentioned, *i. e.*, a combination with a single pollinium directly attached to each corpusculum save the last,

[13] Ibid. 191.

which has two pollinia[14]." This is a plain admission that the view that the pollinia are inserted by the corpuscula will not account for the formation of dichotomous combinations of pollinia, and involves the whole theory of the insertion of pollinia by the corpuscula. For if a pollinium in a dichotomous combination can be inserted by the knee, any other pollinium may be inserted in the same way, and the theory of insertion by the knee may be applied throughout without meeting any difficulty. The supposition that the pollinia are inserted by the knees explains the formation of these as well as of unilateral ones, and shows the value of both forms; for the combination becomes the equivalent of a leg provided with a number of pollinia, each one of which may be inserted separately.

Finally, I have seen the pollinia of A. Sullivantii introduced into the stigmatic chambers in the manner above described. The pollinia and the entrance to the chamber in this species are very large and are easily seen, and hive bees move so slowly in effecting pollination that, after a knee is caught, one can see the pollinium slowly disappear between the wings, so that there can be no doubt as to the manner of insertion. Commonly, however, the insertion of pollinia occurs so rapidly that it is impossible to see how it really happens. After a pollinium has been introduced into the chamber, hive bees always have difficulty in breaking the retinaculum, and they lose their lives on account of this as well as on account of the difficulty in drawing their claws through the slit. When a foot is held by a retinaculum the pollinium is found in the chamber, with every indication that it was introduced by the knee.

EXPLANATION OF FIGURES ON PLATE VIII.—1. Flower of *A. Sullivantii* Engelm (sepals and petals removed). 2. Anther wings of same. 3. Stigmatic chamber. 4. Pollinia when first withdrawn. 5. Same after twisting of retinacula. 6. Same, seen from the side.

a. anther wing. *c.* corpusculum. *e.* entrance to stigmatic chamber. *k.* knee. *r.* retinaculum. *s.* stigmatic chamber. *p.* pollinium.

[14] Ibid. pp. 191, 192.

Certain chemical constituents of plants considered in relation to their morphology and evolution.*

HELEN C. DE S. ABBOTT.

The writer has been engaged for some time upon the study of plants by means of proximate qualitative and quantitative chemical analysis, in which the latest methods advanced by Dragendorff were followed. The facts obtained from these studies tend to show a chemical progression in plants, and a mutual dependence between chemical constituents and change of vegetable form.

All plants which were known to contain *saponin* were examined to determine the correlation between this constituent and the accompanying morphological forms. It was found that these saponin plants occupied the great middle plane of M. Edouard Heckel's scheme of plant evolution.[1] M. Heckel arranges all plants within three divisions: 1. Simplicity of floral elements; 2. Multiplicity of floral elements; 3. Condensation of floral elements, and in addition he bases his theories upon three characters: Filiation, adaptation, and progression. These laws as well as the three divisions of development, are not only elements of test for the great divisions, but are to be found in orders, sub-orders and classes. It is a significant fact that all the saponin groups belong to this middle division, or multiplicity of floral elements. Saponin is thus a constructive element in developing the plant from the multiplicity of floral elements to the cephalisation of those organs. It is an indispensable principle in the progression of certain lines of plants, passing from their lower to their higher stages. Saponin is invariably absent where the floral elements are simple; it is invariably absent where the floral elements are condensed to their greatest extent. Its position is plainly that of a factor in the great middle realm of plant life when the elements of the individual are striving to condense and thus increase their physiological action and the economy of parts. All the great groups which contain saponin are closely allied and possess other properties in common, as fibrous or bulbous roots, rootstocks, tubular character of some part of the flower, and a climbing tendency in *Smilaceæ* and some of the *Sapotaceæ*.

Numerous analogous examples of a correspondence between morphology and chemical constituents were advanced, and the following conclusions reached:

* Abstract, by the author, of a paper read before the A. A. A. S., Buffalo meeting, 1886. Evolution used in the sense of progression.

[1] Les plantes et la théorie de l'evolution, *Revue Scientifique*, 13 Mars. 1886.

1. A similarity of one or more chemical constituents is to be found in all plants which are equally developed, and on the same evolutionary plane.

2. The evolution of chemical constituents in which they follow parallel lines with the evolutionary course of plant forms, the one being intimately connected with the other, and consequently that chemical constituents are indicative of the height of the scale of progression, and are essentially appropriate for a basis of botanical classification. In other words, that the theory of evolution in plant life is best illustrated by the chemical constituents of vegetable form.

The reasons offered in favor of a chemical basis of classification are:

1. The disagreement among botanists themselves, depending upon the insufficiency of the present methods of classification.

2. Chemical constituents, or the constructive elements of form are intimately associated with the origin and progression of plant life, and are consequently better adapted for classification than organs and tissues because as component parts less complex.

3. By the invariable composition and structure of given determinate chemical constituents.

4. The percentage of any given compound in a plant would gauge the progression or retrogression of a plant, species or genus, and would accentuate the characters of progression, adaption, and filiation.

5. Variations in chemical constituents would be detected by analysis earlier than consequent variations of organs or tissues.

6. It is a law of internal influences controlling function and modifying forms rather than of external forces, hence a study of the elements of the innermost structure of plant life is a study of that law and of life itself.

All chemical constituents will not answer as means of classification for the same great evolutionary plane, though any compound might be found to furnish a basis for the division of plants into classes, orders, sub-orders, genera and species.

Albuminous compounds and chlorophyll are less likely to be serviceable as compounds of classification. They are intimately associated with the manifestation and continuance of the conditions of life though they are not regarded as the essential factors in development.

The chemical study of plants is meant to include microchemistry in its application to histology and physiology, in determining the position in the cell of any chemical compound, and qualitative and quantitative analysis to be practiced in accordance

with the schemes of Dragendorff and others. I should suggest that analysis be made of each part of the plant, as of the root, stem, bark, wood, leaf, flower, and seeds; also of the separate organs of plants, *i. e.*, in the flower, of the stamens, pistils, petals, calyx, and of various plants under various conditions of age, climate, soil and seasons. Under these conditions a comparison of chemical constituents with plant structure would lead to a comprehension of the correlation between morphology and chemistry.

BRIEFER ARTICLES.

An interesting Peronospora.—The *Peronospora graminicola* Schr. is abundant here this season on Setaria viridis. Dr. Farlow gives a description of the species in the BOTANICAL GAZETTE, March, 1884, p. 39, after which he says: "This curious species, for which Schroeter has created the sub-genus *Sclerospora*, has been found in several European countries, but is at present only known at La Crosse (Minn.) in this country." The specimens gathered here are more vigorous, seemingly, than those from which the description of the species was made. For example, the conidiophores, instead of being solitary or sparingly branched, are clustered and much branched. But that which will most interest all lovers of the Peronosporæ is the fact that this mildew attacks the spikes of the Setaria and frequently distorts the floral parts beyond all recognition. Herewith is shown[1] a "head" of the foxtail flowers, drawn natural size. Instead of the apparently cylindrical spike, three or more inches long, with its many long bristles, there is a smooth head, or short spike of floral parts, as shown at *a* in the engraving. Rarely more than one head in the same plant is thus deformed. With few exceptions, the essential parts of the affected flowers are either abortive or wanting. At *b* is shown a spikelet double its natural size. The affected floral parts are usually of a purplish color, and abound in the oöspores of the Peronospora. In many of the palets and flowering glumes the thick-walled, dark brown or chestnut oöspores are so numerous as to occupy nearly all the space within the epidermis.

On other culms without flowers the upper leaves are frequently very stiff, upright and colored dark brown. In such the oöspores have formed in countless numbers.—BYRON D. HALSTED, *Agricultural College, Ames, Iowa.*

John Goldie, gardener and botanist.—John Goldie was born near Maybole, in the district of Carrick, Ayrshire, on the 21st March, 1793. Having selected gardening as an occupation, he was for a time under instructions in the art in the gardens of Kilkenam, a residence of the Fergusons, an Ayrshire county family, situated on the Girvan river in Carrick. At an early period of his career he became associated with Mr. James Smith, well known in his day

[1]See plate VIII.

as a botanist and horticulturist, and to whom is credited the introduction into cultivation of what is now known as the Kilmarnock weeping willow, which, it is said, he discovered amongst some of the hedges of Ayrshire.

When Hen Ainslie, the well known American naturalized poet, was a young man making the tour, the fanciful account of which he afterwards published under the title of "A Pilgrimage to the Land of Burns," he visited, amongst other places worthy of note, Mr. Smith's residence and gardens, known by the name of Monkwood Grove, situated on the banks of the classic Doon, and puts on record a very pleasing picture of the place and its occupant and its botanical treasures.

In the year 1815 Mr. Goldie married Margaret Ballantyne Smith, daughter of his preceptor. An incident of his early youth was his appointment as botanist on an exploring party being sent out to Africa by the British government. When preparing himself and in full expectation of going, he was, from some unexplained cause, superseded at the last moment, which he had no cause afterwards to regret, as the expedition turned out abortive, nearly all the members succumbing to the terrible African climate.

For the purpose of more thoroughly studying botany, he became connected with the botanic gardens at Glasgow, and in company with the lamented botanist and traveler Douglas studied botany under Sir William Hooker, who was at that time curator of the gardens, and whose lifelong friendship he afterwards enjoyed.

He paid his first visit to America in 1817–18, and at Montreal made the acquaintance of Frederick Pursh, one of the pioneer botanists of this continent, and at that time residing at Montreal; congeniality of tastes resulting in Mr. Pursh furnishing him with useful letters of introduction to people throughout the country likely to aid him in his researches. Returning home in 1818, he revisited America in 1819–22. His diary, still preserved in manuscript, records his starting on foot from Montreal on the 4th June, 1819, and in this way making the journey up the St. Lawrence, with a divergence to the Lake Simcoe neighborhood, passing through the city of Toronto, at that time called Little York, and along the beach near Hamilton, without observing or being made aware of any nucleus of a city where Hamilton now stands. The Niagara Falls were, of course, a point of special interest, and the diary is illustrated with a pen and ink plan of it. From the falls his course lay through parts of New York and Pennsylvania and through that part of the latter which has since become known as the oil regions. Footing it away out from Pittsburg, the diary dates his arrival at what was called in the locality Oil creek, so named from an oil that was seen to rise to the surface in many places, thick, dark-colored, and having a strong bituminous smell. Some soldiers, marching from Pittsburg to Detroit, were said to be the first to report the discovery of this oil, the virtue of which as a cure for rheumatism they also found out, the march in the wet having made many of them victims to it.

The diary, of course, makes many references to the plants noted in the different localities, and his services to the science were recognized by English botanists in annexing his name to a fern, Aspidium Goldianum, which he was the first to describe and procure specimens of.

On returning to Scotland, after this second American tour, he was in the year 1824 recommended by Mr. McNab, of the Edinburgh Botanical Gardens, to collect and take charge of a vessel load of plants to be taken to St. Petersburg for the starting of a botanical garden there, in which mission he acquitted himself to the satisfaction of his employers. On his return from this expedition he settled down with his family in the nursery business, but returned to Russia again in 1830 and made a collecting excursion through the country, amongst some of the fruits of which was the introduction to the English horticultural world of such plants as the Picea pictita, Pavenia tenuifolia plena, etc. From this time till the year 1844 he followed the business of nurseryman and florist at the old home near by to the birthplace of the poet Burns, a few miles from the town of Ayr.

In 1844, having formed a favorable opinion of Canada West as a place of emigration, in which he might have a chance to better the circumstances of himself and family, he took ship with his entire household, for Montreal, and from there journeyed westward and chose as a resting-place a spot near some of his old-world neighbors, about a mile from Ayr, in the county of Waterloo, where he died, surrounded by children, grandchildren and great-grandchildren, last June, in his ninety-fourth year.

Desmodium molle DC.—This species, heretofore accredited to Florida, seems to be no nearer to us than St. Thomas of West Indies, Panama, and tropical South America. It should be dropped from our catalogues. The plant described under that name with doubt by Chapman, and on that authority entered in Watson's Index, is *D. tortuosum* DC. To it are to be referred *No. 30 Garber's South Florida Fl.*, and *No. 623 Curtiss' N. Am. Pl.* Its more distant verticels of filiform, recurved, thrice longer (9″) pedicels, and its pendulous loments of 4-6 equal, twisted, 2″ long, fertile joints, sufficiently distinguish *D. tortuosum* from the following:

D. molle DC.; *? Macf. Fl. Jam.; Benth. in Fl. Brasil.; Griseb. Fl. Brit. W. Ind.; not Chapm.* (*No. 361 Eggers' Fl. Ind. Occ.*)—Probably distinct from every other known species by its loment. This is 2- or occasionally 3-jointed; upper joint only perfecting seed, flat, oval, enlarged (3″ long) and detaching itself at maturity, suture notched at insertion of seed; lower joints minute, undulate-twisted, sterile, persistent.—JOHN DONNELL SMITH.

Testa of the seeds of Phytolacca[1].—Being engaged in a study of Phytolacca, and noticing the paper of Mr. L. H. Pammel on the structure of the testa of several leguminous seeds, published in the *Bulletin of the Torrey Botanical Club*, February, 1886, at Dr. Coulter's suggestion I made an examination of the testa of the seeds of Phytolacca, with the following results: There are four distinct regions: 1. The palisade layer (I). This layer consists of flat very thick-walled cells, each containing a very irregular cell cavity, completely filled with a large granular mass and numerous small granules. The thick walls contain a brown pigment, and are roughened all over by small projec-

[1] See plate VIII.

tions. These cells vary in shape, some being almost wedge-shaped. 2. The next region (II) contains four or five layers of thin-walled cells, which are somewhat irregular, sometimes five or six-sided in section, separated by a few intercellular spaces, and containing a small amount of coloring substance. 3. The third region (III) is decidedly a pigment layer. The cells are small, regular and thick-walled. 4. The innermost region (IV) contains two layers of nearly empty cells. They are thin-walled, with the exception of the wall next the nucellus (V), and somewhat rectangular. It will be noticed that the "crystal layer" found in many of the harder seeds is entirely wanting.—CHAS. U. STOCKBARGER, *Wabash College, Indiana.*

Some notes on Hypericum.—Since the publication of my revision of North American Hypericaceæ in the BOTANICAL GAZETTE for April and May, 1886, I have received some very interesting material from Dr. A. Gattinger, of Nashville, Tenn., who has for many years been making a careful study of the state flora. Tennessee seems to be a center for this group, where northern and southern forms mingle. Eighteen species of Hypericum are found within its borders, and it is not wonderful that in some of its almost inaccessible regions a new species has been discovered.

A very interesting discovery is that of *H. Kalmianum* L. in the oakbarrens of Tullahoma, Middle Tennessee, July 10, 1882. Heretofore thought to be restricted to the region of the great lakes, its occurrence in this widely separated locality is very unexpected. As a rule the specimens seem more robust than their northern representatives, but not more so than some specimens I collected last August at Point Abino, near Buffalo. It would be interesting to learn more of the surroundings, but "oakbarrens" give us probably the same conditions of soil as are found to favor the northern forms.

In the revision referred to a separation is made between H. Kalmianum and the group containing H. prolificum and H. densiflorum upon the basis of five- and three-celled capsule. Undoubtedly this distinction occasionally breaks down, as H. Kalmianum is found with capsules four- to six-celled, and the capsule of H. densiflorum is often four-celled, while the new species described below combines characters of both groups, and forms a complete transition from H. Kalmianum to the species that follow. While these exceptions show that the division is not an absolute one, it still is the rule, and furnishes as good a distinguishing character as can be expected in species so closely allied. For the present, then, the new species, while it is undoubtedly most closely related to H. densiflorum and H. prolificum, will be grouped most conveniently with H. Kalmianum, on the basis of a five celled capsule, as follows:

3.* **H. lobocarpum** Gattinger, n. sp.[1] Shrub, five to seven feet high, with upright branches: leaves as in *H. prolificum:* flowers as in *H. densiflorum:* sepals not foliaceous, linear-lanceolate: capsule two or three lines long, lanceolate and tapering to the long strong beak, completely five-celled and deeply five-lobed, in most cases the five carpels almost distinct, and at maturity falling away from a central axis.—Low swampy lands, in the Orange sand formation, near Hol-

[1]Announced to the Botanical Club of the A. A. A. S., Buffalo meeting, 1886.

low-rock, Carroll Co., West Tennessee, collected first in fruit, September, 1867 in flower, July, 1886, *Gattinger*; also, "W. Mississippi or E. Tennessee," *Dr. J. T. Stewart*, 1863. Dr. Gattinger describes it as "growing in a swampy region difficult to penetrate, amidst Rosa Caroliniana and Nyssa aquatica." He found two shrubs, and no more. The Stewart specimen is in the Harvard herbarium, and is simply a fragment of a fruiting specimen which has remained undetermined, but it is undoubtedly this species. The great peculiarity consists in the deeply five-lobed capsule, which is more differentiated than in any other member of the genus and serves well to distinguish the species. Some species are slightly lobed, but in this case the carpels seem almost distinct and are simply held together by their attachment to a central axis, from which they fall away at maturity. The size and general habit of the plant are like H. densiflorum, with perhaps even denser flower clusters, while the broad leaves are exactly those of H. prolificum. Mr. Canby has collected New Jersey forms of H. densiflorum bearing the leaves of H. prolificum, which closely resemble H. lobocarpum, except in the capsule characters. Dr. Gattinger is to be commended for the persistence with which he urged the claims of this species to recognition.—JOHN M. COULTER.

How the humble-bee obtains nectar from Physostegia Virginana.—While passing through a patch of the "False Dragon-head," I noticed that a goodly number of a large species of humble-bee were alighting *on* the flowers and darting their heads deep in between the calyx and corolla, at the upper side of the latter. At first I thought they were collecting nectar from between the calyx and corolla, and commenced to look for the glands. But on inspection, I found that on the upper side of many of the corollas, near the base, was a longitudinal slit, usually near one-third inch long. This was the case in nearly all the older flowers examined, while in those just opened, or still opening, the slit was usually absent. On gently pressing down on the outer portion of the slitted flowers, I found that the sides of the opening were thrown apart, thus exposing the upper portion of the four-lobed ovary and lower parts of the pistil and stamens, and making access easy to the nectary glands at the base of the ovary. In addition to the humble-bee there were a number of other insects visiting the flowers, but they entered in the usual way, through the corolla. It is not unusual to find tubular flowers, especially the closed gentians and Tecoma radicans, with holes eaten through them near the base, through which insects pass in and out, which holes are nearly always made by ants. But I do not remember to have seen any record of instances where an insect made a slit, through which to collect the sweets of a flower.—J. SCHNECK, *Mt. Carmel, Ill.*

Home-made bacteria apparatus.—For the cultivation of bacteria and other microscopic organisms certain utensils are essential, others are very serviceable without being indispensible. The German investigators have given much attention to the construction of incubators, sterilizers, culture vessels of various kinds, implements and accessories in great numbers, and of convenient utility. If it is desired to fit up a complete laboratory for the study of these

low organisms, and the means are at command, it is doubtless best to send to Berlin[1] for the equipment. But for many who have not large bank accounts, and who are still desirous of learning or teaching something concerning bacteria, a few lines about inexpensive, home-made apparatus may prove acceptable.

The necessities are: (*a*) A good microscope, of which nothing further need be said, (*b*) a dry sterilizer, (*c*) a steam sterilizer, (*d*) a water oven or incubator, (*e*) moist chambers, (*f*) test-tubes, (*g*) inoculating needles, (*h*) soft glass tubing, (*j*) pincers.

The dry sterilizer may be made of sheet-iron ("Russia" preferable), and if the walls are double all the better; but the common ovens sold with "oil" stoves may be easiest procured, and answer every purpose. The side door is in

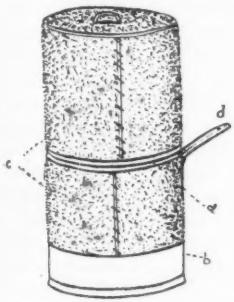


Fig. 1. Steam Sterilizer. *a*, place of division; *b*, protecting ring of tin outside the felt cover; *c*, felt covering; *d*, handle at extreme top of lower division.

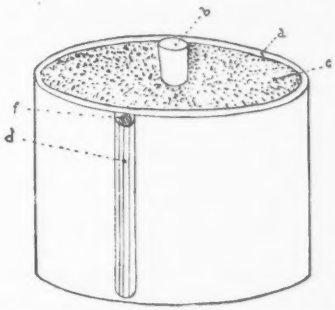


Fig. 2. Incubator. *a*, Double wall for water space; *b*, opening with collar to serve for the insertion of thermometer and for handle; *c*, felt covering on cover; *d*, nose piece for filling water space, observing height of water and for thermometer or gas-regulator; *f*, opening in outer wall of vessel for exit of air and steam.

every way preferable to a cover at the top. The bottom should be perforated to admit the flame and a false bottom pierced with small holes, except near the central area, placed an inch above. Several moveable shelves are required. The size must depend upon the amount of work to be done, but in any case one square foot for the base is little enough, and a greater height is preferable. In this all vessels and utensils which will stand a high temperature, as well as a quantity of cotton-wool for plugs, are to be sterilized by heating to 150° C., or more. It is a good place to keep a supply of test-tubes, etc., ready for use. Keep a quantity of cotton in the upper space. Let this be separated into pellets big enough for plugs before sterilizing.

The steam sterilizer (fig. 1) is a very useful vessel for sterilizing fluids in flasks, test-tubes, etc., and anything else that will not permit a high dry heat. It is used for filtering gelatine, etc., for making meat broth, cooking potatoes and the like. It should be cylindrical in shape, not less than six inches in diameter of base and one foot in height. It should be divided into two equal parts,

[1] Or to Eimer and Amend, 205-211, Third Ave., N. Y. City.—Eds.

so that the upper part may be lifted off and the lower half used by itself. A cover like that of an ordinary tin pail is used. A perforated false bottom (readily removable) is fitted on suitable supports one and a half inches from bottom. When in use this space is to be filled with water. This vessel may be made of tin, but copper is better. Over the outer surface thick felt (to be obtained at the saddler's) may be sewed by bringing the ends snugly together after placing the piece around each cylindrical portion of the vessel. The felt on the cover may be held in place by three or four little "tongues" soldered to the upper surface, passed through the felt and bent down. To protect the felt from the flame a band of tin two and a half inches wide should be fastened around and allowed to project a half inch below the bottom, the lower edge being turned in and up against the vessel.

I can not help but feel that the sterilizer is much simpler than this description. The figure may help to a comprehension of the latter. If tin is used the cost need not be over one dollar and a half, and a dollar more for copper.

The incubator (fig. 2) ought to be made of zinc or copper, preferably the latter. The cheapest (though not the best) form is cylindrical with circular cover. The bottom and side walls must be double so as to leave a three-fourths inch water space. The side walls are closed at the top. Two half-inch holes are to be cut through the outer vessel, one at the *extreme* top vertically over the other near the bottom. At this place a vertical nose-piece three-fourths of an inch in diameter extends the entire height of the vessel covering the holes just mentioned. This is for filling the water space, and for the insertion of a thermometer or gas regulator, as well as to indicate the height of the water within. The cover may be single tin covered with felt, or better (in service, but more inconvenient to handle), of copper, and double for water. In the latter case a side projection containing water connected with that inside will be necessary for heating by a special lamp. An inch hole fitted with an upright collar is to be provided in the cover for the insertion of a thermometer. With the double cover a second hole leading to the enclosed water is desirable for a second thermometer. It is surprising what difference in temperature there is between top and bottom of the space in such a water oven when the cover is single tin unprotected by felt or some such substance—by far too much for the results required. No doubt a thick pine-wood cover, lined with tin beneath, would answer well the requirements. The difficulty which one finds in any such incubator is to keep the temperature uniform and not *too high*. With gas, the simplest way is to have an ordinary lava-tipped burner (instead of a Bunsen burner as commonly used) turned low enough to make the flame nearly or quite blue, and then regulate the amount of heat required by the distance from the vessel to the flame. A small kerosene lamp, "night lamp," may be utilized to good purpose. An incubator as described, of copper with felted tin cover, can be made for four to six dollars.

Moist growing chambers can be satisfactorily secured by the use of a small plate or saucer and the largest goblets or tumblers procurable. A simple circle made of a strip of zinc an inch wide will serve as a support for the glass culture plate. The latter can be cut from good window glass the size of the moist chamber, or less, if desired. In moist chambers it is usually wise to use a one

per cent. aqueous solution of corrosive sublimate instead of pure water. In this case the support for the culture plate should be glass or porcelain. Individual butter plates or saltcellars may be utilized.

Test-tubes five inches long by three-fourths of an inch wide are the most convenient. Instead of these, half-ounce bottles of elongate form and with wide mouths may be used with equally good results.

For inoculating or transferring needles for cultures, platinum is the best. When this is not attainable use brass wire. Heat the end of a slender glass rod five inches long until soft and thrust the wire into the glass for a handle. The wire may be three inches long. One of these should be hooked at the end.

Small sized glass tubing, suitable for drawing out into capillary pipettes, is indispensible for the inoculation of culture liquids through the cotton-wool stopper. This tubing can be found at any chemical laboratory, or may be had of any dealer in chemist's supplies. The same may be said of suitable pincers for handling the sterilized cotton. The latter should not of course be taken in the fingers when corking the test-tubes. The rubber cloth called by dentists "rubber dam," and to be had of them, is serviceable for capping cotton-stoppered tubes or bottles to prevent evaporation. Cut the rubber into suitable squares, and hold in place with a common elastic band. If test-tubes are used a beaker with a little cotton in the bottom serves well for holding, or a little basket can readily be made of screen wire cloth.—T. J. BURRILL.

EDITORIAL.

THE BOTANICAL SPIRIT has been so rampant and the botanists so numerous at the recent meetings of the American Association that there have been frequent suggestions of breaking up the biological section into its constituent parts, or at least of making a section of botany. It is urged that the interests of the present section are so diverse that it is already found convenient to group its papers by subjects for the convenience of those who have no desire to listen to the discussion of all biological subjects, and that botany and zoology have no more relation to each other than certain other distinct sections, and not so much as both to geology. There are several objections to making the proposed change that might be profitable to consider. In the first place, after botany and zoology have been separated they no more embrace single interests than the whole subject of biology, and what is to be the fate of the great field of physiology, so ably represented at the Buffalo meeting? In the second place, such a division, so far as botany is concerned, would simply convert the Botanical Club into a section of botany. This would change a pleasant, informal, social affair into a stiff, business-like, and somewhat heavy body; the small notes, the personal suggestions, the hundred things which are often far more personally beneficial than weighty papers, would be eliminated, and we would predict for the section of botany not a tithe of the attendance, interest, or enthusiasm enjoyed by the Botanical Club. In the third place, the very fact that

there is great diversity of interest in a section makes it a far more comfortable one to be associated with, as it does not compel a burdensome attendance, and gives chance to learn something of the other work of the Association, as well as to cultivate friendships. As it is, the section of biology burdens no one, excepting its officers, and yet one can hear everything he desires. Botanical papers are good things, but botanical papers morning, noon and night for days in succession would become tiresome even to botanists. Then there is great objection to excessive subdivisions in the matter of machinery and reference of papers. The machinery is already cumbersome enough, and even now papers are often doubtfully referred. For instance, such papers as that of Dr. Salmon, on immunity from contagious diseases, would be almost impossible to refer properly in the proposed division. Large in attendance and diverse in interest as the section of biology is, we believe it as yet gives the most convenient and complete arrangement of subjects and opportunities that can be made.

THE TIME being nearly at hand for putting together and summing up the results of the year's work, suggests the consideration of a class of public institutions, having more or less to do with botany, whose annual reports may properly be the subject of criticism: we have in mind the experiment stations dealing with agricultural and allied subjects. Their work is two-fold in character, and may accordingly be separated into the popular and the scientific. This distinction has been admirably defined and elucidated by Dr. Bessey, who points out the need of fostering both these branches of research. The former appeals to the man who desires to apply the knowledge toward securing increased commercial value for his labors, and the latter to the man who desires to apply it toward the establishment of some new principle or fact of universal accuracy. Experimental work is likely to furnish data for both purposes. But, as observed by Lord Rayleigh, in his Montreal address, "detached and ill-assorted facts are only raw material, and, in the absence of a theoretical solvent, have but little nutritive value." It is this want of digestion which does much toward rendering the majority of experiment station reports a conglomeration of details, explanations, facts, deductions, illustrations and hypotheses, which neither the commercial nor scientific man is disposed to work over into useable shape. A decided advantage might be gained by placing the undigested facts and other separable data by themselves, which would bring the directly applicable part of the report into readable compass. A division of the latter into the commercial and the scientific could then be made. The commercial part should be non-technical, and be a clear statement of the results of the year, in so far as they may be of value to the farmer, gardener, stock-raiser, etc. The scientific part should state with equal clearness and brevity the facts and deductions of permanent and universal value, and point out their relation to what has been previously established. Some such plan of making the material of these reports more available would add to the good reputation of the institutions and to their usefulness.

OPEN LETTERS.

Spores of Pilobolus.

At the Buffalo meeting of the Botanical Club of A. A. A. S., Dr. Farlow spoke of an instance in which *Pilobolus* threw its spore cases a distance of eight feet. I have just observed in a dark stable, not often used, where there is a dirt floor, that these black "specks" are very thick and some of them rise to a perpendicular height of six feet, certainly, and very likely a little higher. I examined some of them and they are not "fly-specks." W. J. BEAL.

Agricultural College, Michigan.

Viola tricolar, var. arvensis.

Seeing by the GAZETTE for September that Dr. Gray wishes to know whether Viola tricolar, var. arvensis is established as a wild plant or not I might say that the above plant has been firmly established in one of our fields for at least ten years, and is steadily spreading itself over the whole farm.

Woodstock, Ontario. THOMAS P. HART.

Vegetable substance within animal tissues.

A case of the organization of a vegetable substance within animal tissues reported in the *Revue de Chirrugie*, August, 1886, may be of interest to your readers.

Prof. C. Vaulair, of Liège, was experimenting on the tubo-suture of nerves, using rubber drainage tubes, as decalcified bone was too speedily absorbed.

A tube of gray vulcanized caoutchouc was used, $1\frac{1}{4}$ metres long, $\frac{1}{3}$ inch thick, walls $\frac{3}{50}$ inch thick.

The experiment was successful as regards the regeneration of the nerve. But in $7\frac{1}{2}$ months it was found the tube was being absorbed, and finally it disappeared. Under the microscope the tube showed a more or less homogeneous parenchyma, and a large number of blood vessels. The stroma formed a compact resisting mass of fine interlaced connective tissue fibers, and cells occupying the interfascicular spaces.

The cells averaged twenty micro-millimeters; some were polygonal, others elongated. The cells had large nuclei. The connective tissue took a bright rose stain in boracic carmine.

The vessels were numerous and of the capillary type; in some the walls were of a continuous layer of elements, flattened and resembling normal vascular endothelium; there were also other types.

The outer surface of the tube was irregular and fungous: the inner surface smooth, and showed no distinct line of demarcation from the subjacent tissues. At its lower part the tube had become assimilated to the surrounding connective tissues, and had finally disappeared.

Your readers will observe that this absorption or rather organization of a structureless vegetable exudate is different from the revivification of catgut, bone sponge, etc., where we have the conversion of one animal tissue into another. But heretofore vegetable substances have not become animalized, as far as known, save through the laboratory of the alimentary system.

Your readers will find a more extensive abstract in the *Medical Record*, October 2, 1886. A. W. BRAYTON.

Indianapolis, Ind.

CURRENT LITERATURE.

The Cayuga Flora. Part I: A catalogue of the Phænogamia growing without cultivation in the Cayuga lake basin. Bulletin of the Cornell University. vol. ii. William R. Dudley. 8vo., pp. xxx. 133. v, with 2 maps. Ithaca, 1886.

Professor Dudley has given us one of the most complete and best prepared catalogues we have seen. It may be taken as an example of careful and conscientious work, and aided, as he has been, by specialists in their own groups, every part of it becomes authoritative. The introduction of 30 pages is devoted to the consideration of such subjects as the limits of the flora and its physical characters, the lesser floras which go to make up the larger range of the catalogue, the affinities of the Cayuga flora, the primitive flora, sketch of the explorations, statistics of the catalogue, and comparison with other floras. This region was first botanically explored by Bartram (1743), followed by Kalm (1750), Pursh (1807), Thomas, Aikin, Sartwell, Gray, and others. Since that time many young botanists have aided in the work, until probably no one has ever had more material or better work at his command in the preparation of a catalogue than the author. As for the statistics of the catalogue, it includes 1160 species, 963 of which are natives. Adding the well-marked varieties the number reaches 1278. Of these 381 are Polypetalæ, 350 Gamopetalæ, 133 Apetalæ, 403 Monocotyledons, and 11 Gymnosperms. The large number of monocotyledonous species is made by the two great orders Cyperaceæ (151 species) and Gramineæ (107), while monocotyledonous genera number but 101, as against 162 polypetalous and 146 gamopetalous genera. Compositæ stand between the two orders mentioned, with 125 species, followed by Rosaceæ (69), Leguminosæ (45), etc. The largest genera are Carex (112), Potamogeton (27), Aster (24), Salix (22), Polygonum (20), Solidago (18), Panicum (17), Juncus (15), etc. Rhexia, Hippuris, Castilleia, and Pogonia pendula are reported as having disappeared. New varieties of Cratægus coccinea and Naias marina are described by the author, and Eatonia Dudleyi, a new species, by Dr. Vasey. The nomenclature has all been brought up to date, accompanied by necessary synonymy, and that the last convenience, even in a catalogue, may not be wanting, an index to orders and genera is appended. It was a pleasant thought that suggested cuts of the pussy-willow for a head-piece and the witch-hazel for a tail-piece, and looking over these well-printed pages one can feel confident that from pussy-willow to witch-hazel all has been well done.

Flower-Talks at Elmridge. By Ella Rodman Church. Philadelphia: Presbyterian Board of Publication. 1885. 12°. pp. 320. Illustrated.

Among the Trees at Elmridge. By the same author and publishers. 1886. pp. 412. Illustrated.

The popularly most interesting phase of botany at the present time is that which looks at correspondences and differences of homologous parts, which discovers adaptations and the means of accomplishing ends, which takes into account the habits, growth and behavior of plants, in short, that which scrutinizes every detail of the plant's structure and appearance, and constantly inquires for the reason of it as looked at from the standard of the plant's needs. It is this form of the subject—the new botany, as it is sometimes inappropriately termed—as opposed to the routine learning of the names of organs and of their shapes and positions, upon which dependence must be placed to redeem the good name of botany from the popular misapprehension that looks upon the science as having as little to do with the verities of active life as do the stories of Greek mythology.

So far as children's books are concerned, the botany which is the most attractive and serviceable in them is the kind that sets the young mind to thinking and stimulates the observation. An incidental requirement is that technical

terms should be kept as much in the background as possible, for children, and older persons as well, often gain the stultifying idea that the hard names are the chief part of the science. The first question must be, "how is it?" with the supplementary inquiry, "what advantage is it to the plant?" and the answer must be obtained directly from the plants themselves, and not through the medium of books.

Both of the books before us are designed for children, more particularly Sunday-school children, and in accordance with a too common custom, for it seems to us unwise, the characters are drawn unnaturally good and polite. Three small children and their governess talk in one book about flowers, and in the other about trees. The author assures us in the preface that the "Elmridge Series," of which the first two volumes are entitled *Birds and their Ways*, and *Flyers and Crawlers*, has been projected especially to open the eyes of the young to the natural objects about them. There is, therefore, no disagreement between the author and the critic in regard to the main objects to be accomplished; and it is a matter of interest to see how fully the aim has been attained. We quote a few lines from the middle of the first volume by way of illustration; the subject is the common blue flag or iris. The governess says:

"You will notice that while the leaves are perfectly straight the flower-stem bends this way and that, which is called *flexuous*; it is quite round, and about two feet long. The stem is also branching, and has several flowers, each with three thick *petals* that curl outward. Botanists call these thick lower petals *sepals*, or divisions of the calyx, while the three upright ones in the center are the real *petals*. The three *stamens* grow from the base of the sepals, and are concealed by the three *stigmas*; which are those three central divisions that resemble petals. The stigmas are cut in two parts at the top. Remove the petals and sepals, and you will see that these three gorgeous stigmas proceed from the same *style* and *germ*, which ripen into a three-celled *capsule*."

"I wish there weren't such hard things to remember about flowers," said Clara. "I like the flowers so much that I want to know all about them, but I mix up all the sepals and things."

"You need not, dear," replied her governess, laughing; "all that you need to remember at present is that sepals belong to the cup or bottom of a flower, and petals to the top or corolla. As Malcolm is the oldest of the party, I shall expect most of the remembering to be done by him."

Malcolm made a grimace, too, at the sepals and petals, but manfully said that he would do his best.

We fully side with the children, and see no reason why these technical terms should be used, as it seems unnecessary to introduce them just to point out the parts, and all the other information could have been as clearly expressed by the use of every-day words. We feel sure that the great botanist, Dr. Asa Gray, would agree with us, for in his account of the curious construction of this same flower, in his work *How Plants Behave*, he calls the parts "divisions, or leaves of the flower," instead of petals and sepals, as so strenuously urged in the quotation. The idea is not that technical terms should be entirely discarded, but that they should be used only where an obvious necessity exists, in reality very few being needed by the child-botanist. Fortunately for the little ones, the governess does not always feel it incumbent upon her to be so strictly "botanical," and many pleasant and instructive observations upon the history and habits of plants are scattered through the volumes.

It is pleasant to remark a noticeable freedom from scientific blunders, there being none worth mentioning, unless one takes account of a few like the loose use of the words "stigma" and "germ" in the quotation. The author is evidently upon familiar ground. What we have to regret is that she was not better acquainted with some of the features of botany referred to in the beginning of this notice, to which the juvenile work by Dr. Gray, already mentioned, may be cited as a stepping stone.

Guide to the recognition of the principal orders of Cryptogams and the commoner and more easily distinguished New England genera, with a glossary. By Frederick Leroy Sargent. Cambridge: Charles W. Sever, 1886. 12°. pp. 39, interleaved.

The author tells us in the preface that he has attempted "to bring together in systematic form and in a convenient shape such information as would enable

a student to learn to recognize a number of the commoner conspicuous genera of cryptogams." The idea is an excellent one. Probably all who are conversant with the subject will agree that our text-books have been inadequate heretofore for the needs of the student who desires to readily provide himself with some knowledge of the names and relationships of the plants he sees about him, especially of the lower forms.

The printer and the binder have done their parts well, and the text has an attractive appearance, as if it deserved its excellent setting. But the value of a *guide* lies in its usefulness when put to the test. Here is the result of our trial. The first thing that came to hand was a thalloid liverwort. Turning to the key, we find two grand divisions, "Cormophyta" and "Thallophyta." The first includes "plants in which (with few exceptions) there is a well-marked differentiation into caulome and phyllome." Our plant evidently does not fit here, unless it be one of the exceptions, which unfortunately are not enumerated, but must go into the next division, where such differentiation is not well-marked. Under this are the groups, algæ, fungi, and lichenes, and with the characters of the first of these our plant does not conflict, but turning to the descriptions of the orders of algæ, we find ourselves quite astray. Going back to the beginning again, we conclude to assume that this may be one of the exceptions hinted at in the first line of the key. This gives a choice between Phanerogamia, Pteridophyta and Bryophyta, which are distinguished by the presence or absence of seeds and fibro-vascular bundles. As our plant appears to have neither of these structures, we place it under the last division, and turning to the description of the orders, have little doubt that it goes with Marchantiaceæ. But here are only two genera (Lunularia and Marchantia), distinguished by gemmæ, which our specimen does not have. As we are still as much in the dark about the true position of the plant as when we started, we take down Underwood's *N. Amer. Hepaticæ* and find that it is Conocephalus conicus, more commonly written Fegatella conica, everywhere a very common liverwort.

Fearing this may not be a fair test, we take the next thing at hand, and have a white mildew on lilac leaves. There is no trouble in placing this under the fungi, and running it into the Perisporiaceæ, but here we find "genera not given".

These examples will serve to make clear some of the limitations of the work. (*a*) No guard is provided for preventing the student being led astray by non-typical forms or misinterpretation of structures. Even plain "exceptions" are not always specified. (*b*) When a handbook is made to cover only the more common plants of a region, the user can rarely be certain that he has not stumbled upon a plant which is omitted, and this casts a doubt upon the correctness of his work with the key. Very few plants indeed, could be omitted if every one were included that is common at some locality or other over a large region. (*c*) The number of orders under which the genera are given is surprisingly small. The two genera of Characeæ are the only ones given among fresh-water algæ, and those of but three orders are given among marine algæ. Only four orders of fungi have the genera given, Gasteromycetes, Hymenomycetes, Tremellineæ, and Discomycetes, but these embrace the largest and most conspicuous of the fungi. The genera of lichens are enumerated as an independent group.

The above criticisms may be interpreted as meaning that the work does not meet the expectations raised by its title. But we may turn about and criticise the title, as too ambitious for the work it is attached to. A guide is for the use of those who do not know the way, and to serve its purpose must therefore be reliable in all cases. The present work can not be said to meet this requirement. But instead of calling this a "guide," suppose it be named an "abbreviated synopsis"—the criticisms we have made lose their force, and the work will still serve the same ends the author has apparently designed it to quite as well. We think that a serviceable guide is feasible and desirable, but it must be

more elaborate than the present work, and as we have good manuals of the mosses and liverworts, it need not cover more than the thallophytes.

Professor Sargent's work will be an excellent one to place in the hands of students who are under the eye of a teacher. It will assist the student in many cases to learn something of the chief characters of the specimens he has found, and usually to learn enough for him to readily turn to some larger handbook and pursue his inquiries.

Lectures on the Physiology of Plants. By Sydney Howard Vines, M. A., D. Sc., F. R. S., Fellow and Lecturer of Christ's College, Cambridge, and Reader in Botany in the University. 8°. pp. x. 710. Cambridge: University Press. 1886. [New York: Macmillan & Co.]

In this delightful volume—delightful typographically and intellectually—Dr. Vines presents his lectures on physiology to a wider audience than can gather about his desk at Cambridge. The work of preparing these lectures for the press began in 1877, before there was "any text-book in the English language treating at all fully of the physiology of plants so as to meet the requirements of advanced students." Various delays prevented its appearance until more than six months after the publication of Dr. Goodale's admirable work with which American students are now familiar.

Assuming a previous knowledge of histology, Dr. Vines' book is purely physiological. It shows throughout its pages the influence of Michael Foster, to whom the author acknowledges his indebtedness. Undoubtedly this influence has had much to do with the excellence of the treatment. Certainly the author has given us a work on vegetable physiology which is a worthy companion to Dr. Foster's well known text-book on animal physiology.

The broad topics of the book are discussed in the following order: Structure and properties of the cell, absorption, movement of water, transpiration, food, metabolism, growth, irritability and reproduction. At first glance it would seem that too much space had been allotted to irritability, but when it is seen that under this head the author treats the relations of plants to external influences, such as light, heat and electricity, together with their movements in response to internal stimuli, of whose nature we are ignorant, the apparent disproportion vanishes. Warmly to be commended is the concluding portion of the last lecture on irritability, in which is discussed the biological significance of this property in plants.

Of the six lectures on metabolism (we are glad to substitute this well-founded physiological term for metastasis), two are specially devoted to a consideration of the "supply of energy" and the "expenditure of energy," and throughout the work the broad principles of the conservation of energy in their vital relations to the assimilative and metabolic activities of the plant are kept constantly before the mind of the reader. No one feature is more to be commended than this, for in no other work have these relations been so clearly set forth.

The last eighty-five pages contain a fine summary of the reproductive process, tracing these from their lowest terms in the protophytes to their most complicated form in the phanerogams, together with a condensed statement of the more prominent theories of reproduction.

The excellence of such a work disarms criticism. One could wish, however, that some topics had been treated in greater detail. A notable omission, for instance, is that of any account of the processes of nuclear division. The reversed use of the terms dorsal and ventral, as applied to leaves, is calculated to confuse, and is of doubtful utility.

If we compare Dr. Vines' work with its only English contemporary, it will be seen at once that Dr. Goodale's book is decidedly more comprehensive, treating with greater or less fullness almost every topic of vegetable physiology, and

including innumerable things of less importance which the college student or general reader is sure to desire to know. While Dr. Vines' book lacks this somewhat encyclopedic character, it treats more elaborately the larger topics, and in a way suited only to advanced students. It therefore supplements its predecessor in such a way that no one can do without either.

NOTES AND NEWS.

PROFESSOR C. R. BARNES has returned from Cambridge to the duties of his professorship in Purdue University, Ind.

THREE NUMBERS of Cooke's British Desmids are now issued. This work forms a continuation of the author's British Fresh-water Algæ.

REV. J. M. CROMBIE begins an Index Lichenum Britannicorum in the last number of *Grevillea*, after the most recent Nylanderian arrangement.

DR. MAXWELL MASTER'S "Vegetable Teratology" has been translated into German by Mr. Udo Dammer, and published by Hässel, of Leipzig. Additional notes and wood cuts have been added.

MR. FREDERICK LEROY SARGENT has accepted the Chair of Botany in the University of Wisconsin, at Madison, which was resigned by Prof. A. B. Seymour. Mr. Sargent has already entered upon his duties.

MR. HARVEY THOMSON, for several years Professor Coulter's assistant, has accepted the professorship of botany in Hastings College, Hastings, Nebraska. His position at Wabash College has been filled by Mr. J. N. Rose.

THE ADDRESS of Mr. Carruthers, president of the biological section of the British Association at the recent Birmingham meeting, dealt with the past history of those plants which still form a portion of the existing flora.

PROF. C. S. SARGENT writes that there should be added to the published list of Dr. Engelmann's publications (BOTANICAL GAZETTE, May, 1884) his paper on "The Genus Euphorbia in DeCandolle's Prodromus", *Am. Jour. Sci.* II. xxxiv. 288-291.

THE COMMON stink horn (Phallus) sometimes becomes very obnoxious when growing near dwellings. W. G. Smith, in the *Gardeners' Chronicle*, recommends trying a strong solution of carbolic acid to destroy the fungus and prevent its starting again.

CYPRIPEDIUM ARIETINUM in the mountains of China is a notable addition to an already very considerable list of disjoined species, divided between E. North America and E. Asia. It is announced by M. Franchet in *Bull. Soc. Bot. de France*, xxxiii. 206.

THE SEASON of 1885 in Nebraska and Iowa gave a heavy crop of the cluster-cup on green ash, Æcidium Fraxini, but the trees are almost free from it the present year. A query as to the cause of this unexpected change is raised by Professor Bessey in the last *American Naturalist*.

THE NAVAJO names of plants are treated of in an entertaining article by Dr. W. Matthews in the September *American Naturalist*. The list comprises about one hundred species, including many small or inconspicuous kinds, which it is surprising the Indians should have names for.

MR. ERWIN F. SMITH, recently assistant in the botanical laboratory of the University of Michigan, has received the appointment as assistant in the mycological section of the U. S. Department of Agriculture. He will first take up the study of the Fusicladium and Morthiera of fruit trees.

DR. HENRY LESLIE OSBORN, professor of Zoölogy in Purdue University, has undertaken the editorship of the *American Monthly Microscopical Journal* during the absence of Mr. Hitchcock in Japan. Dr. Osborn is an expert in histological manipulation, and looks upon the microscope in the true light as a *means* and not the *end*. This means that the *Journal* will be ably edited, and with special reference to *useful* work with the microscope.

C. H. STOWELL has severed his connection with the *Microscope*. The August number contains his valedictory, and also a most uncalled for and ungentlemanly attack upon the *Am. Mo. Microscopical Journal*, and particularly its editor, Mr. Romyn Hitchcock. No private quarrel could justify such public insolence.

THE "HERBARIUM HEUFLERIANUM" of cryptogams is for sale, on account of the death of the owner. It contains 1,431 genera, 8,614 species, and about 30,400 specimens, including many type specimens. Further information can be obtained by addressing Paul Baron Hohenbühel, Innsbruck, Universitätsstr. No. 3, Tirol, Austro-Hungary.

MR. ERNEST FREUND, of Vienna, claims to have found cellulose in the human blood and organs in tuberculous disease, and concludes that cellulose is a typical constituent of tubercles and of the blood in tuberculosis. Heretofore the occurrence of cellulose in animal tissues was thought to be restricted to a few invertebrate families.

A REVISION of the Phalloids, or stink horn fungi, has recently been made by Dr. Fischer in which eleven genera and seventy-three species are recognized. The old genus Phallus is discarded. About a dozen species are recorded from North America, four from Europe, and seven from Asia. They are most numerous in the southern hemisphere.

IN THE LAST Bulletin of the Buffalo Society of Natural Sciences, Vol. V, No. 2, Mr. David F. Day gives a list of additions to his excellent catalogue of Buffalo plants. The Naturalists' Field Club of that city is an exceedingly active organization, and it would seem strange if any plants escaped them. About 125 species are included in these additions.

THE METHOD used by Dr. A. F. W. Schimper to study the distribution of starch in leaves is to first place them in alcohol from twelve to twenty-four hours, then transfer to an iodized solution of chloral hydrate, eight parts of chloral to five of water. By this means the leaves become very transparent, and the smallest grains of starch, stained blue by the iodine, are clearly visible under the microscope, even in the deepest-seated cells.

THE PRINCIPAL articles of the *Bulletin of the Torrey Club* for September are Naiadaceæ in the Torrey Herbarium, with plate, by Thomas Morong, Synopsis of the Genus Paspalum, by Geo. Vasey, Dehiscence of Fern Sporangia, by Joseph Schrenk, and Proceedings of the Botanical Club of the A. A. A. S. at Buffalo. The new species described are *Potamogeton Wrightii* Morong from the Loo Choo islands, and *Paspalum Buckleyanum* Vasey from Texas.

THE THIRD BULLETIN of the *Société Mycologique de France*, recently received, contains several papers on hymenomycetous fungi by MM. Quélet, Lucand, Forquignon, Gillot, Mougeot, Barla, and Brunaud. The other principal articles are the Role of ptomaines and leucomaines in mushroom poisoning, by Dr. L. Forquignon; Note on a case of poisoning by mushrooms, by Dr. Kuhn; and On the microscopical study of mushrooms, by M. Boudier.

MACLEOD AND MILLER have been investigating cholera during the past year in Shanghai. They found Koch's comma bacillus in twenty-five out of twenty-seven cases. The germ is destroyed by drying, but if kept moist is capable of growth after four months. The question as to whether it enters the body through inspired air or the alimentary canal finds upholders for the first position in Emmerich and Buchner, working in Sicily, for the second, Koch and the general opinion.

REMARKABLY REDUCED trichomes in some species of Campanula have been described by E. Heinricher in the *Berichte der deutsch. bot. Gesellschaft*. They form peculiar small plugs in about the middle of the outer walls of the epidermal cells on the upper surface of the leaves. They are covered with a thin cuticle, and often show divisions. The discovery was made in C. persicæfolia, but they also occur in C. grandis and C. patula, and presumably in other smooth, or nearly smooth, leaved species.

DR. MILLER, of Austria, finds that the germs of zymotic diseases are destroyed in the stomach when its reaction is acid. If, however, bacilli and bacteria are passed into the stomach before the hydrochloric acid of the gastric juice is poured out they pass on into the intestine uninjured. It has been observed that persons are more likely to be attacked by cholera when the stomach is diseased. As it is generally thought that the germs of these diseases are introduced by the alimentary canal, these observations of Dr. Miller are extremely valuable.

TWIN TREES are often recorded, and a recent account of one near Tunbridge Wells, England, brings them to mind. In the case referred to an oak and a beech have grown together so as to form a single trunk for five or six feet. In another case the old oak has a birch tree growing out of it, but the latter has evidently germinated where a branch of the oak had been broken off eight or nine feet from the ground. The birch is now six or eight inches in diameter, and its roots reach through the internally decayed oak to the ground.

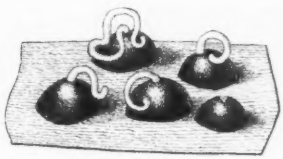
A HYBRID ORCHID between Cattleya intermedia and Sophronitis grandiflora, produced by Veitch & Sons of England, has been referred by Prof. Reichenbach to the genus Lælia. It is quite remarkable that a hybrid should fall into a different genus from the parents and the wonder is not much diminished, but takes on another form, when we learn that this has led Prof. Reichenbach to reexamine the characters of these genera, and with the result that he decides that all of the species but one of Sophronitis should be tranferred to Lælia, including S. grandiflora.

M. CORNU has found by culture experiments conducted the present season (*Compt. Rendu de l' Acad.*, 1886, p. 930) that the spores of Peridermium Pini, var. corticolum sown upon Vincetoxicum officinale produce in about four weeks Cronartium asclepiadeum. It has been known since 1873 that Coleosporium Senecionis and Peridermium Pini, var. acicolum are alternate forms of the same fungus. It is now apparent that these two forms of Peridermium are really specifically distinct. This gives further evidence that we shall be unable to fully classify the pleomorphic fungi until their life histories are known.

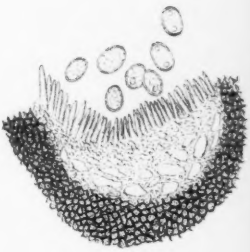
DAVIES' SMALL WORK on the "Preparation and mounting of microscopic objects", a 16mo. of some 200 pages recently sent us by the American publishers, J. H. Vail & Co., of New York, attests its substantial character by having reached the twelfth thousand. It is now in essentially the same form as left by Mr. Matthews of the Quekett Club, who edited the second edition about twelve years ago. Although it does not describe some valuable processes which have come into use since the author's time, and is not a work for the specialist, yet it is still almost as serviceable as at the time it was published, for that considerable class of microscopists who desire to prepare a cabinet of mounted specimens of curious and interesting objects, selected from the whole vegetable and animal kingdom. The author tells in a clear and trustworthy manner how to prepare, preserve and mount such objects.

THE BOTANY of the U. S. Department of Agriculture Report for 1885, which was distributed some time ago, is of all degrees of value and accuracy. The most important thing in bacteriology is the identification of the bacterium of swine-plague, and the discrimination between this disease and the rouget, or swine-plague of Europe, studied by Pasteur. The seed and forestry divisions require no notice. The report of the superintendent of grounds gives much space to mildews, peach-leaf blister, peach yellow, pear blight, cracking of pears, potato rot, etc. The most courteous thing we can say of this is, that it is "crude, owing to want of practical knowledge"—words which we find in the report. The microscopist has a short compilation regarding edible mushrooms, illustrated with a colored plate. The botanist's report gives a brief description of a score of foreign and native medicinal plants, with cuts, and a page of notes on grasses. The remainder of it is devoted to fungous diseases of plants, contributed by the assistant botanist, together with a short account of smut in timothy by Professor Trelease, and is worthy the careful attention of cultivators and students of fungi.

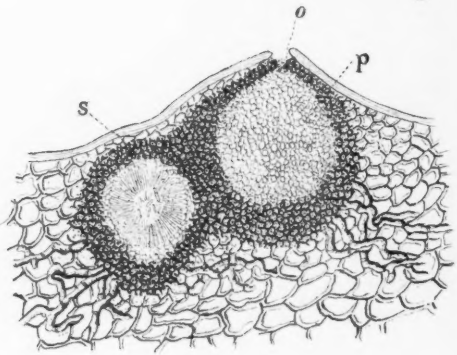
THE COMMITTEE of the British Association on fossil plants made an interesting report at the recent Birmingham meeting. Attention was devoted last year exclusively to phanerogams. They find that many of the so-called monocotyledons have been disproved and that that group can not boast of as great antiquity as has been claimed. The oldest monocotyledons seem referable to the Pandanæ, a group now distributed in widely distant and remote oceanic islands, and whose fruits are still met with at sea in drifts of vegetable matter. Very likely the Aroideæ have been proved to be of high antiquity. In reference to the naming of fossil plants from fragmentary material, a habit which has in some cases reached an absurdity, the committee utters a wise protest. It does appear, they say, that it would have been wiser and more consistent to have taken the absence of fruit into account, when these were such as would naturally have been preserved. The large proportion of fossil dicotyledonous leaves, that have been referred without any hesitation to living genera, must strike every one, in comparison with the relatively few associated fruits that have been determined otherwise than as Carpolithes, a name which is a confession of failure.



1

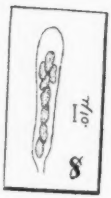


3

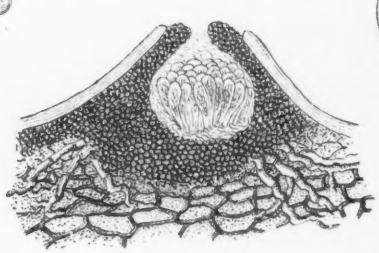


2

4



8



5

6

7

F.L.S. del.

Heliotype Printing Co.

SCRIBNER ON BLACK ROT.